FINAL
RECORD OF DECISION
SCOTTSDALE GROUND WATER OPERABLE UNIT
INDIAN BEND WASH
SUPERFUND SITE
SCOTTSDALE, ARIZONA

September 1988
RDD63592.RA
Work Assignment 029-9L20.0

CONTENTS

TABLES

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(continued)

RDD/R74/002

I. DECLARATION FOR THE RECORD OF DECISION

SITE

Indian Bend Wash (IBW) Superfund site, Scottsdale Ground Water Operable Unit, Scottsdale, Arizona.

PURPOSE

In accordance with the National Contingency Plan; the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA); and the Superfund Amendment and Reauthorization Act of 1986 (SARA), potential remedial actions have been developed for the Scottsdale Ground Water Operable Unit. This decision document represents the selected remedial action. The Operable Unit has been developed to provide potable water for the City of Scottsdale and addresses ground water contamination only in the Middle and Lower Alluvium Units beneath the north portion of IBW within the Scottsdale city limits (see Figure I-1). Contamination beyond these limits in the ground water of the Upper Alluvium Unit and in the soils will be addressed separately in subsequent operable units for the IBW site. The Arizona Department of Water Resources and the Arizona Department of Environmental Quality concur with the selected remedy.

BASIS

This decision is based on the administrative record for the IBW site, which includes the results of the Remedial Investigation and the Scottsdale Ground Water Operable Unit Feasibility Study. Appendix A identifies the items contained in the Administrative Record upon which the selection of the remedial action is based.

DESCRIPTION

The IBW study area lies in the southwestern Paradise Valley encompassing approximately 13 square miles in Scottsdale and Tempe, Arizona. The study area is bounded on the north by Chaparral Road, on the east by Pima/Price Road, on the south by Apache Boulevard, and on the west by Scottsdale/Rural Road. The Salt River flows through the study area from east to west, physically separating the site into north and south areas. The area south of the river is suspected to have other source areas than those suspected in the north, and is being considered for a separate operable unit by the U.S. Environmental Protection Agency (EPA).

An Operable Unit is a discrete part of an overall site and can be examined separately if the remedial action for the

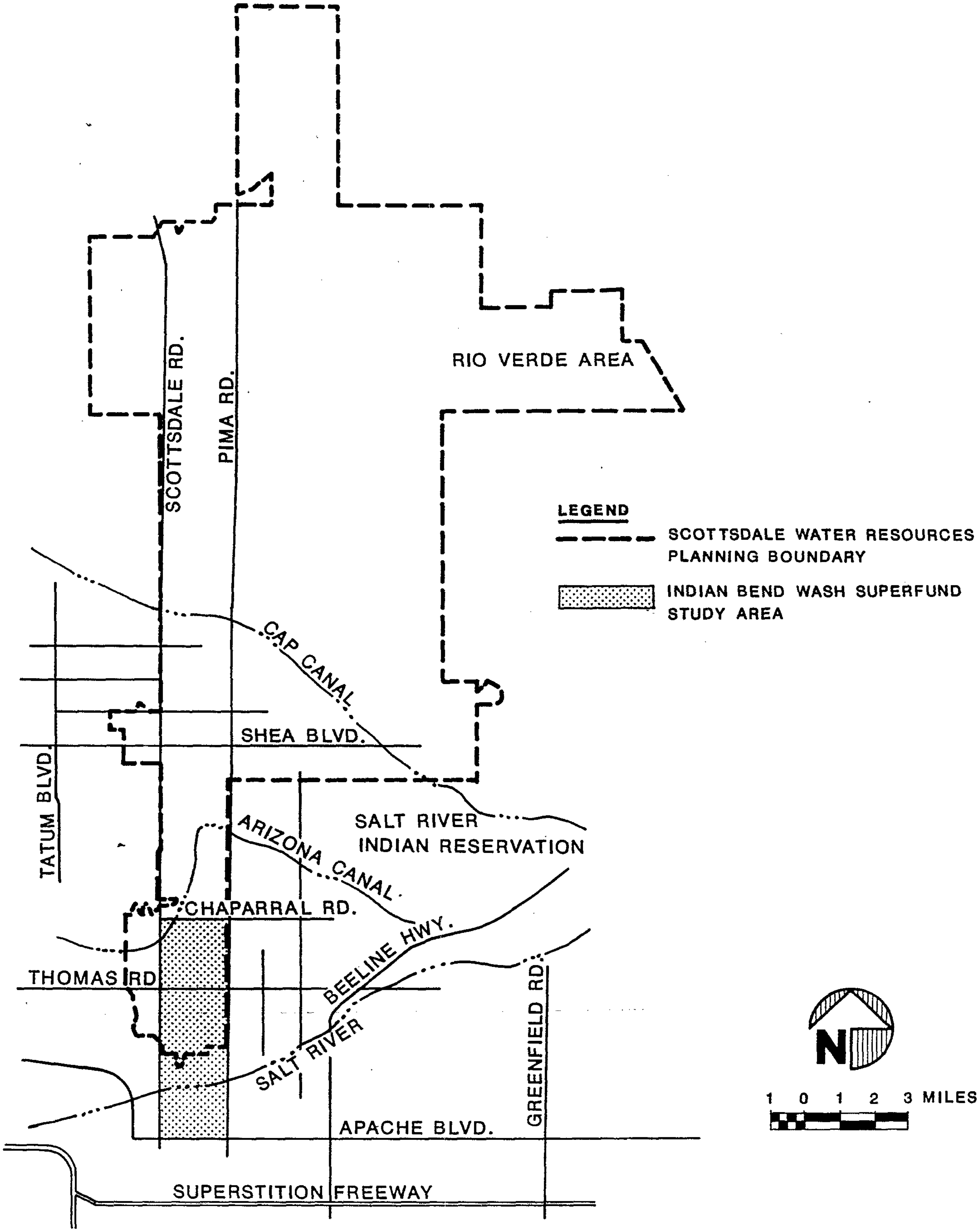

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FIGURE I-1
PROJECT LOCATION MAP
INDIAN BEND WASH SCOTTSDALE ROD

Operable Unit can be done expeditiously, is cost-effective, controls contaminant sources or migration, and is consistent with the final site remedy. The Scottsdale Ground Water Operable Unit is the portion of the study area within the Scottsdale city limits. There are 12 city wells within the Operable Unit, 7 of which have levels of volatile organic compounds (VOCs) exceeding primary drinking water standards. Figure I-2 shows the locations of the 12 wells. Presently, one of the seven contaminated wells is equipped with a VOC treatment facility and used as a potable water supply source. The remaining six are currently offline. Wells No. 31, 71, 72, and 75 are being considered for treatment under this Operable Unit. In addition, several monitor wells screened in the Middle and Lower Alluvium Units have higher concentrations of VOCs than the city wells.

The Scottsdale Ground Water Operable Unit has been developed to address the following objectives:

- Protect public health and the environment by protecting unaffected wells from VOCs.

- Provide a mechanism for the long-term management of the VOC-affected ground water in order to improve the regional aquifer's suitability for potable use by the City of Scottsdale.

- Provide a potable water source for the City within the constraints of projected water demands while utilizing existing facilities to the maximum extent feasible.

One of the remedial actions developed to meet these objectives involves extracting ground water from the Lower and Middle Alluvium Units by pumping existing municipal wells that are currently not in use and are screened in these units.

The selected remedial action meets the above objectives. The major components of the remedy involve pumping Scottsdale Wells No. 31, 71, 72, and 75 at 75 percent of their historical capacities. Preliminary analysis indicates this pumping regimen will reduce the mass of contaminants and volume of contaminated ground water in the Lower and Middle Alluvium Units. Once the system is operating and the effectiveness of removing VOCs from the Lower and Middle Alluvium Units is evaluated, additional pumping of these wells and the installation and pumping of additional extraction wells will be considered. Levels of contaminants in the extracted ground water will be reduced to meet drinking water standards. Air stripping is the preferred treatment alternative to meet these criteria, and will include air emission controls. The treated water will be delivered to the City of Scottsdale municipal water system.

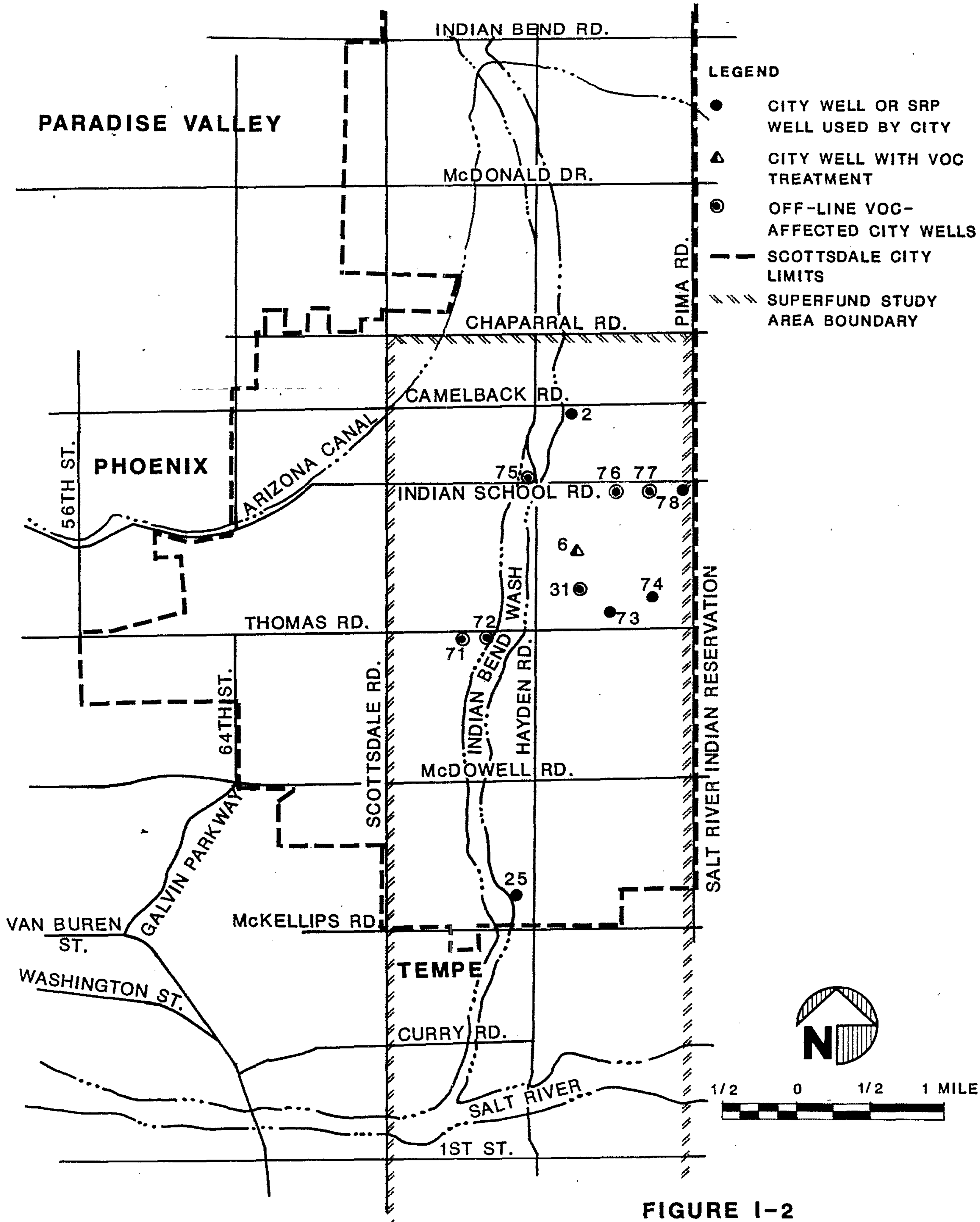

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FIGURE I-2
CITY OF SCOTTSDALE
WELL LOCATIONS
INDIAN BEND WASH SCOTTSDALE ROD

DECLARATION

The selected remedy for this Operable Unit is protective of human health and the environment, meets Federal and State requirements that are applicable or relevant and appropriate, and is cost-effective. This remedy satisfies the preference for treatment that reduces toxicity, mobility, or volume as a principal element. All substantive permit requirements will be met during implementation of this remedial action. It is determine that the remedy for this Operable Unit uses permanent solutions and alternative treatment technologies to the maximum extent practicable. The Arizona Department of Environmental Quality and the Arizona Department of Water Resources have concurred with the remedy presented in this document.

9.21.88
Date

Daniel W. McGovern
Daniel W. McGovern
Regional Administrator
Region IX

9.20.88
Date

John Wise
John W. Wise
Deputy Regional Administrator
Region IX

RECORD OF DECISION
CONCURRENCE PAGE

Site: Indian Bend Wash Superfund Site, Operable Unit, Scottsdale, Arizona

The attached Record of Decision package for the Indian Bend Wash Superfund Site, Operable Unit, Scottsdale, Arizona, has been reviewed, and I concur with the contents.

8/22/88 Date	Nancy J. Marvel Nancy Marvel Regional Counsel Office of Regional Counsel U.S. Environmental Protection Agency, Region IX
9-19-88 Date	J B Zelikson Jeff Zelikson Director Toxics & Waste Management Division U.S. Environmental Protection Agency, Region IX
Date	Harry Seraydarian Director Water Management Division U.S. Environmental Protection Agency, Region IX
Date	David P. Howekamp Director Air Management Division U.S. Environmental Protection Agency, Region IX
Date	Nora McGee Acting Assistant Regional Administrator Office of Policy and Management U.S. Environmental Protection Agency, Region IX

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Nancy Marvel
Regional Counsel
Office of Regional Counsel
U.S. Environmental Protection Agency, Region IX

Date

Jeff Zelikson
Director
Toxics & Waste Management Division
U.S. Environmental Protection Agency, Region IX

September 14, 1988
Date

Keith Takata
Harry Seraydarian
Director
for Water Management Division
U.S. Environmental Protection Agency, Region IX

Date

David P. Howekamp
Director
Air Management Division
U.S. Environmental Protection Agency, Region IX

Date

Nora McGee
Acting Assistant Regional Administrator
Office of Policy and Management
U.S. Environmental Protection Agency, Region IX

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Date	Jeff Zelikson Director Toxics & Waste Management Division U.S. Environmental Protection Agency, Region IX
Date	Harry Seraydarian Director Water Management Division U.S. Environmental Protection Agency, Region IX
Date	David P. Howekamp Director Air Management Division U.S. Environmental Protection Agency, Region IX
Sept. 1, 1988 Date	Nora M. McGee Nora McGee Acting Assistant Regional Administrator Office of Policy and Management U.S. Environmental Protection Agency, Region IX

II. SITE DESCRIPTION

The Indian Bend Wash site encompasses approximately 13 square miles in Scottsdale and Tempe, Arizona (see Figure I-1). The Scottsdale Ground Water Operable Unit area covers approximately 8 square miles in the southeast portion of the Scottsdale city limits. Approximately 70 percent of the area is classified as residential. Approximately 23 percent is used for commercial and light industrial purposes, with the remaining 7 percent as developed open space. Land use patterns in the area are not expected to change.

The Indian Bend Wash itself runs north/south through the site and supports recreational uses. In the past, the ponds in the Wash were used as a water collection system. The water would eventually discharge to the Grand Canal. After contamination was detected in the surface water of some of the ponds, ground water was no longer discharged to the Wash. Currently, the City of Scottsdale pumps water into the ponds as needed to maintain the surface water for fishing, where allowed, and for the aesthetic qualities it provides to the Wash.

Scottsdale provides water and sewer for most of its residents. The City relies on ground water for approximately 70 percent of its municipal supply, with the additional 30 percent supplied by surface water from the Central Arizona Project.

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III. SITE HISTORY AND BACKGROUND

SITE HISTORY

In 1981, trichloroethene (TCE) was discovered in the ground water from several City of Scottsdale and City of Phoenix municipal wells at concentrations exceeding Arizona Department of Health Services action levels in effect at that time. The contaminated wells included City of Scottsdale Wells No. 6 and 31, and City of Phoenix Wells No. 34, 35, and 36 (currently Scottsdale Wells No. 75, 72, and 71, respectively). These wells were removed from potable use. Well No. 6 was equipped by the city with a VOC treatment system and returned to potable use in 1985.

IBW was added to the National Priorities List in 1982, and a Remedial Investigation began in July 1984. The Remedial Investigation is being conducted by EPA in cooperation with private companies and State and local agencies. EPA has identified several facilities within the site boundaries that have records of past use of TCE in their manufacturing processes. Two of these facilities, Motorola and Beckman Instruments, have been identified as Potentially Responsible Parties and are participating in the RI/FS.

The Remedial Investigation has focused on collecting ground water, soil, and soil gas samples for chemical analyses, and defining ground water flow in the study area.

SITE CHARACTERIZATION

The climate of the Scottsdale area is characterized by long hot summers and short mild winters. Climate information for Phoenix, Arizona, indicates the annual average daily temperature is 85°F for the high and 55°F for the low. Precipitation is in the form of rain and averages 7 inches per year. Winds are predominantly from the west at 6 miles per hour (Climates of the States, 1980).

The IBW study area is underlain by alluvial sediments which can be divided into three hydrostratigraphic units. These units consist of the Upper Alluvium Unit (UAU), the Middle Alluvium Unit (MAU), and the Lower Alluvium Unit (LAU). The UAU varies in thickness; however, in the vicinity of the study area, the thickness of the UAU is approximately 120 to 160 feet. The UAU consists primarily of sand, coarse gravel, cobbles, and boulders in this area. Ground water occurs at depths ranging from approximately 90 feet to approximately 130 feet, with up to 40 feet of saturated thickness. The saturated thickness of the unit changes with the time of year, but generally decreases to the north. Ground water in the UAU appears to be flowing in a west-northwest direction.

The MAU primarily consists of silt, clay, and interbedded fine sands. Relatively thin layers of coarser deposits are scattered throughout the unit. Ground water flow in the MAU appears to be toward the north-northwest in the study area. The thickness of the MAU ranges from approximately 360 to 660 feet. Water levels in wells perforated in the MAU occur at depths of 140 to 180 feet.

The LAU is less well defined. Samples collected during monitoring well installation indicate the unit consists of moderately to well-cemented sands and gravel. The depth of the unit is not well defined; however, it is known that the LAU is underlain by the Red Unit which consists primarily of fanglomerate, conglomerate, and sandstone. The direction of ground water flow in the LAU is thought to be similar to that of the MAU.

Water level data indicate that there is a downward-directed vertical hydraulic gradient between the UAU and the MAU and between the MAU and the LAU.

Ground water quality data indicate contamination at IBW from various organic solvents, particularly TCE, tetrachloroethene (PCE), 1,1-dichloroethene (1,1-DCE), and 1,1,1-trichloroethane (1,1,1-TCA). All of these chemicals have been found in monitoring wells at concentrations exceeding State action levels. TCE is the most widespread contaminant with a maximum reported concentration of 2,500 ppb from a UAU monitoring well. The maximum concentration reported from a Middle or Lower Alluvium monitoring well is 700 ppb. TCE has been detected in several municipal wells at concentrations up to 390 ppb and from depths as great as 1,100 feet below land surface.

Six City of Scottsdale wells are affected by VOC contamination including TCE and lower levels of PCE, 1,1-DCE and chloroform. TCE is the only VOC quantified in samples from these wells at levels that exceed primary drinking water standards. As mentioned earlier, six of the seven affected wells are not currently operating and the seventh (City of Scottsdale No. 6) is equipped with a VOC treatment system. Figure III-1 shows the location of the contaminated City wells.

RECEPTORS

ENVIRONMENT

The environment of the Scottsdale area encompassed by the IBW site is primarily residential, commercial, and industrial. There are no unique habitats or threatened or endangered species. Vegetation of the area is typical of residential and industrial areas for that geographic area.

The Indian Bend Wash, which traverses through Scottsdale, supports some wildlife, primarily fish and waterfowl. Some native fish, such as the Gila sucker (Catostomas insignis) and the roundtail chub (Gila robusta) live in the ponds located along the Wash. These ponds also support populations of largemouth bass (Micropterus salmoides) and carp (Cyprinus carpio).

POPULATION

The resident population of Scottsdale was approximately 115,500 in 1986 according to the population projections issued by the City of Scottsdale (1986). By 1990, the resident population is expected to reach an estimated 129,500, and 180,800 by the year 2000 (City of Scottsdale, 1986). Scottsdale also supports a seasonal increase in population; however, this transient population varies from year to year.

All City of Scottsdale drinking water wells currently in use for municipal supply meet applicable Federal and State health standards. However, future population growth will result in greater usage of ground water resources, particularly in the contaminated areas. If no action is taken at this site and contamination migrates to areas that contribute to municipal ground water supplies, use of the ground water will result in a potential exposure to contaminants through the means illustrated in Figure III-2.

TOXICITY

ORGANIC COMPOUNDS

This group of compounds includes most of the contaminants identified at the IBW site. Several of these compounds--carbon tetrachloride, chloroform, 1,1,1-TCA, PCE, and TCE--may produce liver injury. Carbon tetrachloride and chloroform have more serious effects on the liver than TCE and PCE (Doull et al., 1980). Carbon tetrachloride, chloroform, PCE, and TCE have been classified by the U.S. EPA Carcinogen Assessment Group as probable human carcinogens (Group B2) via ingestion (U.S. EPA, 1986).

Exposures to the above compounds through inhalation may result in central nervous system depression, including anesthesia. TCE has been used as an anesthetic (NRC, 1977). Other effects may include irritation of the mucous membranes of the nose and throat and irritation to the eyes (NRC, 1980). TCE and PCE are also classified as probable human carcinogens (Group B2) by the Carcinogen Assessment Group via the inhalation route (U.S. EPA, 1986).

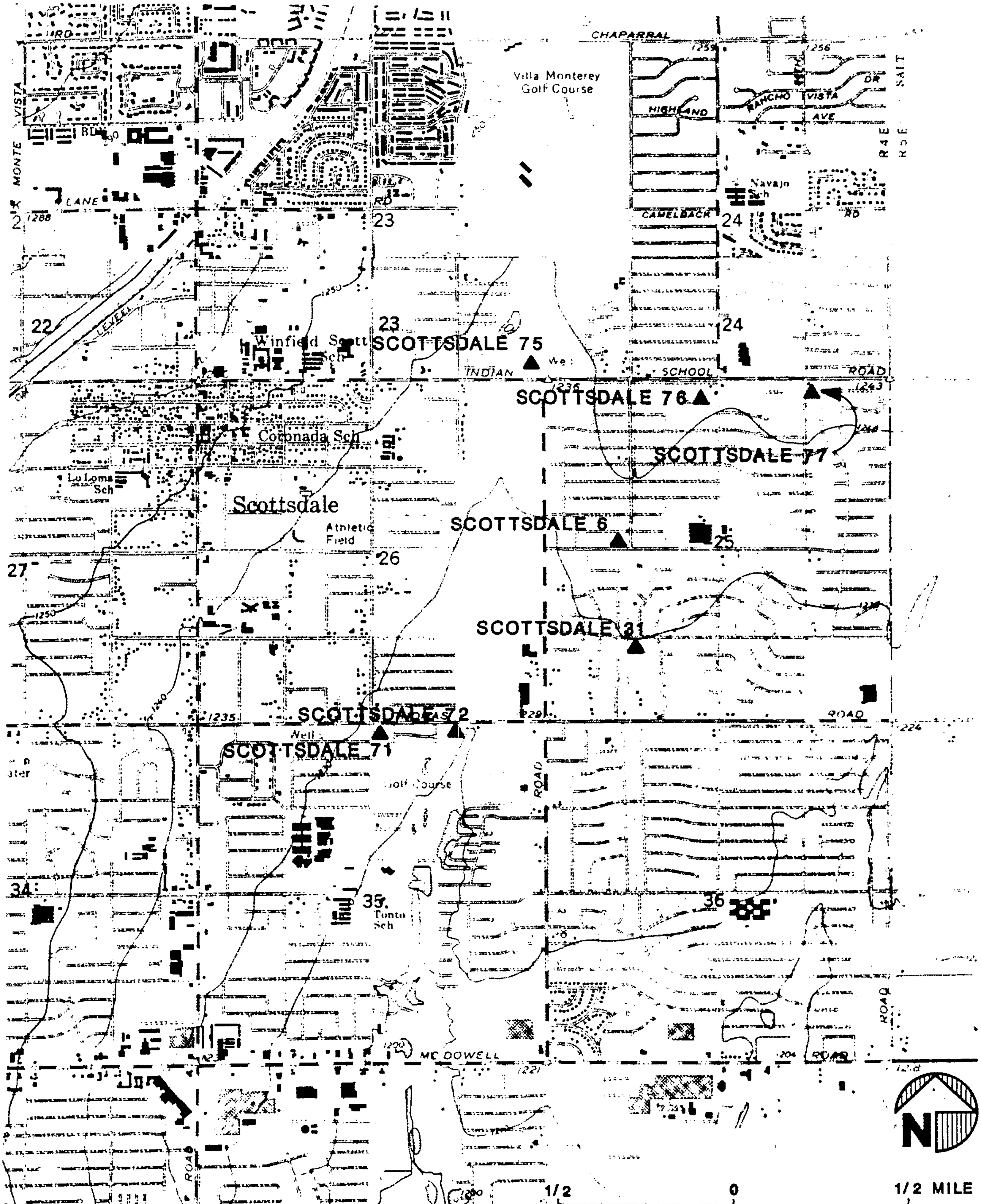

FIGURE III-1
VOC CONTAMINATED
CITY OF SCOTTSDALE WELLS
INDIAN BEND WASH SCOTTSDALE ROD

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MEDIA | **DIRECT EXPOSURE PATHWAY → RECEPTOR**

GROUNDWATER

→ INGESTION BY RESIDENTS WHO USE MUNICIPAL WATER FOR THEIR POTABLE WATER SUPPLY

→ INHALATION OF VOLATILES STRIPPED FROM THE DRINKING WATER DURING IN-HOME USES SUCH AS BATHING AND COOKING

→ DERMAL CONTACT WITH CONTAMINATED DRINKING WATER

FIGURE III-2
POTENTIAL FUTURE EXPOSURE PATHWAY AND RECEPTOR SUMMARY
INDIAN BEND WASH SCOTTSDALE ROD

RDD63592.RA AUGUST 1988

Similar toxic effects to humans through inhalation and ingestion exposures are exhibited by 1,1-DCE. This compound has anesthetic properties, and exposures to high concentrations may cause nausea and vomiting (U.S. EPA, 1985).

RISK

Risk is a function of toxicity and exposure, both in terms of the dose received and the duration of exposure. At present, there is no exposure to contaminated ground water above Federal Primary Drinking Water Standards. However, future use of the City of Scottsdale wells currently not used due to contamination and future migration of the contaminants could affect plant and animal life, and human exposure to the contaminated ground water may result in excess lifetime cancer risks as shown in Table III-1.

The risk associated with exposures to contaminated ground water, particularly for future use scenarios, is an excess lifetime cancer risk that may be as high as 3×10^{-4} to 1×10^{-8} due primarily to the presence of PCE and TCE. This assumes that an individual ingests 2 liters of water daily for 3 months each year over the course of a 70-year lifetime. It is assumed that the 3 months constitute the peak demand months of summer when surface-water supplies may be limited and ground water resources would be necessary. Noncarcinogenic effects resulting from ingestion exposure to 1,1-DCE, PCE, zinc, and lead are of concern.

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Table III-1
SUMMARY OF EXPOSURE ROUTES AND RISKS

Medium	Exposure Setting	Exposure Route	Results
Ground water	Residential--Potential Future	Ingestion	The estimated excess lifetime cancer risk from ingestion of ground water from the Beckman monitor wells presents a 1×10^{-5} to 7×10^{-7} range of additive risk for organic contaminants. A 1×10^{-3} excess lifetime cancer risk was calculated for arsenic; the MCL of 50 μg/l for arsenic was not exceeded in this well. The daily intake of lead resulted in a daily intake that exceeded the AIC for the 18- to 70-age category. At this time, the lead found in the ground water sample is not believed to be the result of disposal activities in the area. The concentration of lead did not exceed the MCL of 50 μg/l. For other noncarcinogens evaluated, there does not appear to be an ingestion risk based on the limited available data. For the various municipal wells evaluated, an estimated excess lifetime cancer risk from ingestion presents a 1×10^{-6} to 6×10^{-9} range based on the organic contaminants with cancer potency factors. A 1×10^{-3} excess lifetime cancer risk was calculated for arsenic; however, the MCL of 50 μg/l was not exceeded for any of the wells. There is no known ingestion risk due to noncarcinogens from these wells based on the limited available data. The estimated excess lifetime cancer risk from ingestion of ground water from the EPA

Table III-1
(continued)

Medium	Exposure Setting	Exposure Route	Results
			monitor wells presents a 7×10^{-5} to 2×10^{-6} range of additive risks for organic contaminants. For noncarcinogens, the acceptable intake or the hazard index were exceeded for the following contaminants and wells: o E-1MA: zinc; 0 to 6 years, AIS; 6 to 11 years, AIS; 18 to 70 years, AIC. o E-2UA: lead, chromium; 18 to 70 years, hazard index. For other noncarcinogens evaluated, there does not appear to be an ingestion risk, based on the limited available data. The estimated excess lifetime cancer risk from ingestion of ground water from the Motorola monitor wells presents a 3×10^{-4} to 2×10^{-7} range of additive risks for organic contaminants. A 3×10^{-3} excess lifetime cancer risk was calculated for arsenic; however, the MCL was not exceeded. For noncarcinogens, the acceptable intake or the hazard index were exceeded for the following contaminants and wells: o M-4UA: 1,1-dichloroethene, perchloroethene; 18 to 70 years, hazard index. o M-5UA: 1,1-dichloroethene, perchloroethene; 18 to 70 years, hazard index.

Table III-1
(continued)

Medium	Exposure Setting'	Exposure Route	Results
			o M-7MA: chromium, nickel, cadmium; 18 to 70 years, hazard index.
			o M-10UA: 1,1-dichloroethene, perchloroethene; 18 to 70 years, hazard index.
			o ST-1: 1,1-dichloroethene, perchloroethene; 18 to 70 years, hazard index.
			o ST-2: 1,1-dichloroethene; 18 to 70 years, AIC (based on maximum concentration). 1,1-dichloroethene, perchloroethene; 18 to 70 years, hazard index (average concentrations).
			o ST-3: copper, zinc; 0 to 6 years, hazard index. 1,1-dichloroethene, perchloroethene, chloroform, copper; 18 to 70 years, hazard index.
			For other noncarcinogens evaluated, there does not appear to be an ingestion risk, based on the limited available data.
			The estimated excess lifetime cancer risk from ingestion of ground water from SRP irrigation wells presents a 2×10^{-4} to 3×10^{-6} range of additive risks for organic contaminants. There is no known ingestion risk due to noncarcinogens from these wells based on the limited available data.
Ground water	Residential--Potential Future	Inhalation	The risk from inhalation of volatiles released from the ground water in the course of in-home uses such as cooking,

Table III-1
(continued)

Medium	Exposure Setting	Exposure Risk	Results
			bathing, etc., cannot be quantified. However, it should be recognized that this exposure could contribute to the overall risk from the use of contaminated ground water.
		Dermal Contact	The risk from dermal contact with contaminated ground water and subsequent exposure to organic contaminants cannot be quantified. It should be recognized that this exposure has been demonstrated to be significant (Brown et al., 1984) and therefore could contribute to the overall risk from the use of contaminated ground water.

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IV. ENFORCEMENT HISTORY

In the Indian Bend Wash area, Motorola, Government Electronics Group (Motorola) and Beckman Instruments, Inc. (Beckman), have received general notice letters compelling their involvement in the Remedial Investigation/Feasibility Study (RI/FS).

The efforts expended by both companies have been investigatory in nature and include such activities as source investigation and ground water monitoring. A history of the administrative orders follow:

Docket Number	Company	Authority
84-01	Motorola	RCRA-3013
84-04	Beckman	RCRA-3013
86-06	Motorola	CERCLA-106
87-05	Motorola	CERCLA-106

Both companies are continuing to participate in the RI/FS. These specific activities include conducting monthly water level measurements, sampling ground water wells quarterly, installing ground water monitoring wells, and conducting other field activities to determine the extent of soils and ground water contamination.

RDD/R85/018

V. COMMUNITY RELATIONS HISTORY

The following is a list of community relations activities conducted by the U.S. Environmental Protection Agency at the Indian Bend Wash Superfund site:

- Conducted interviews with Phoenix, Tempe, and Scottsdale residents and State and local officials to improve the Agency's understanding of community concerns. These interviews provided the basis for the Indian Bend Wash Community Relations Plan released in September 1984.

- Established information repositories at the Arizona Department of Health Services, Phoenix Public Library, Scottsdale Public Library, and Tempe Public Library. Updated repositories periodically with factsheets and other relevant documents.

- Publicized and maintained a toll-free information message line to enable interested residents to call EPA with questions and comments on the Indian Bend Wash Superfund site activity.

- Established and maintained a computerized mailing list with more than 200 names and addresses of interested individuals.

- In July 1984, distributed a letter and factsheet announcing startup of RI/FS activities. A public meeting was held in August 1984 to provide an overview of the Superfund process and to inform interested community members of upcoming RI/FS activities.

- Sent out a factsheet in February 1985 to update the community on RI/FS and enforcement activities.

- In July 1986, distributed a factsheet informing the community about the completion of the Phase I Remedial Investigation Report and other site-related activities including the community well sampling program and the lake and fish sampling program.

- Held a community meeting in August 1986 to update the community on site activities, present the results of the Remedial Investigation Phase I Report, and discuss future RI/FS activities. Approximately 30 people attended this meeting.

- In April 1988, distributed a factsheet informing the community about the cleanup alternatives described in the Operable Unit Feasibility Study (OUFS) and EPA's proposed partial cleanup remedy for Scottsdale's drinking water aquifer.

- Placed public notice advertisements in the Scottsdale Progress and the Phoenix Gazette newspapers announcing the proposed plan and the May 5, 1988, community meeting. Advanced notice flyers were mailed to the site mailing list 2 weeks before the start of the comment period.

- Held a public comment period on the cleanup alternatives evaluated in the OUFS. The comment period extended from April 19 through May 18, 1988.

- Held a community meeting on May 5, 1988, to discuss the OUFS report and EPA's proposed cleanup solution and to accept public comments on the proposed plan. The meeting was attended by approximately 25 persons.

RDD/R4/019

VI. ALTERNATIVES EVALUATION

LISTING OF ALTERNATIVES

The alternatives identified for the Scottsdale Ground Water Operable Unit are broken into two categories: containment alternatives and treatment alternatives.

Containment alternatives were selected to prevent migration of contamination in the aquifers and to mitigate present and future environmental damage. Treatment alternatives were selected based on their ability to remove VOCs from water. Since a major objective of the Scottsdale OUFS is to provide potable water for use by the City of Scottsdale, the water end use is fixed.

CONTAINMENT ALTERNATIVES

The Middle and Lower Alluvium Units have been chosen for remedial action as part of this Operable Unit. These are the units in which the affected wells are screened and serve as a source of potable water to the City of Scottsdale. The Upper Alluvial Unit remedy will be decided in a subsequent Operable Unit. The following containment alternatives were developed for the Scottsdale Ground Water Operable Unit.

- P.0--No action alternative
- P.1--Pumping of existing city wells at their historical capacities
- P.2--Pumping of existing city wells at 75 percent of their historical capacities
- P.3--Pumping of some city wells and addition of three new wells to optimize the aquifer area affected
- P.4--Pumping of city wells for 10 years and subsequent addition of three new wells to optimize the aquifer area affected

Construction of a containment barrier is inappropriate in this case due to the depth of alluvial units, and it does not satisfy the preference under SARA to permanently and significantly reduce the volume of hazardous substances.

TREATMENT ALTERNATIVES

The following options were considered for removal of low concentrations of VOCs from aqueous solutions:

- Stripping (air and steam)
- Activated carbon adsorption
- Reverse osmosis
- Aerobic biological treatment
- Anaerobic biological treatment
- Chemical oxidation

SCREENING OF ALTERNATIVES

As promulgated under CERCLA and SARA, remedial actions are those responses to releases that are consistent with a permanent remedy to prevent or minimize the release of hazardous substances, pollutants, or contaminants so they do not migrate to cause substantial danger to present or future public health or welfare or the environment. SARA, Section 121, states further, "Remedial actions...shall attain a degree of cleanup of hazardous substances, pollutants, and contaminants released to the environment and of control of further release at a minimum which assures protection of human health and the environment. Such remedial actions shall be relevant and appropriate under the circumstances presented by the release or threatened release of such substance, pollutant, or contaminant." SARA also states that remedial actions should be favored that permanently and significantly reduce the volume, toxicity, or mobility of hazardous substances, pollutants, and contaminants. The offsite transport and disposal of hazardous substances or contaminated materials without such treatment should be the least favored alternative remedial action where practicable treatment technologies are available.

The OUFS must also be consistent with the overall site remediation strategy. In keeping with this, the following objectives have been defined for the Scottsdale OUFS.

- Protect public health and the environment by protecting unaffected wells from VOCs.

- Provide a mechanism for the long-term management of the VOC-affected ground water in order to improve the regional aquifer's suitability for potable use and potential recharge/recovery activities by the city.

- Provide a potable water source for the City of Scottsdale, within the constraints of projected water demands, while utilizing existing facilities to the maximum extent feasible.

CONTAINMENT ALTERNATIVES

The no-action alternative must be evaluated as dictated by law and is retained for further analysis.

The four remaining pumping alternatives were evaluated by modeling ground water and transport flow within the affected alluvium units. Table VI-1 summarizes the percentage of TCE estimated to be removed from the aquifer following pumping for various periods. The percentage removed is based on initial mass estimates of TCE and results of the transport flow model presented in the OUFS.

Table VI-1
PERCENT TCE REMOVED

	5 Years	25 Years	50 Years
P.0	6	25	44
P.1	7	45	85
P.2	9	42	79
P.3	6	40	83
P.4	7	41	90

The results indicate that Alternatives P.1 and P.4 are the most effective at reducing amounts of TCE over a 50-year period. However, Alternative P.2 is more effective over a period of 5 to 25 years. It is expected that during operation of the extraction system, changes would be required to optimize the system. These changes are impossible to define at this time.

In addition to being compatible with all the treatment options, P.1 uses only existing wells and appears to be as effective as the remaining options. Therefore, it was chosen for developing system capacities and water quality design criteria to evaluate the treatment options.

TREATMENT ALTERNATIVES

Table VI-2 presents an evaluation of the technologies for VOC removal and screens out those not considered applicable. The water quality design criteria are based on TCE, chloroform, 1,1-DCE, PCE, and 1,1,1-TCA. Air stripping and activated carbon adsorption were retained for the detailed evaluation. The other technologies were dropped from further consideration for a variety of reasons including poor, variable, or unproven performance, institutional and management constraints, or inappropriateness for expected contaminant concentrations.

Table VI-2
SCREENING OF VOC REMOVAL TECHNOLOGIES

Process Description	State of Development	Treatment Capability	Performance Record	Relative Costs Capital	Relative Costs Operation	Waste Streams	Additional Comments	Retained for Further Analysis
Air Stripping	Commercial	Capable of achieving high VOC removal	Excellent	Low	Low to Moderate	Air exhaust (can be treated)	Commonly used for removal of VOCs at low concentrations.	Yes
Steam Stripping	Commercial	Capable of achieving high VOC removal	Excellent	Moderate	High	Small air exhaust, condensate with organics	Not typically used for this type of application.	No--Not well demonstrated for cost removal of low concentrations of VOCs. Much higher energy requirements than air stripping without any significant advantages.
Activated Carbon Adsorption	Commercial	Capable of achieving high VOC removal	Excellent	Low to Moderate	Moderate to High	Carbon with adsorbed organics requires periodic regeneration or replacement	Cost-effectiveness is sensitive to carbon usage rate.	Yes--Useful for vapor and aqueous-phase VOC removal.
Reverse Osmosis	Commercial	Relative poor performance for VOCs	Poor for VOC removal	High	High	Produces a concentrate stream that requires additional treatment	Generally used for removal of dissolved inorganics and high molecular weight organics.	No--Poor performance for VOC removal.
Aerobic Biological	Commercial	Some compounds not readily biodegradable	Variable performance for VOCs	High	High	Sludge requires disposal	May not be stable, susceptible to shock, temperature-dependent; acclimation is important.	No--Variable performance.
Anaerobic Biological	Commercial	May not consistently meet standards	Variable performance for VOCs	High	High	Sludge produced	May not be stable, susceptible to shock, temperature-dependent; acclimation is important.	No--Variable performance.

Table VI-2
(continued)

Process Description	State of Development	Treatment Capability	Performance Record	Relative Costs: Capital	Relative Costs: Operation	Waste Streams	Additional Comments	Retained for Further Analysis
Chemical Oxidation	Commercial	Capable of achieving high VOC removal	Applicable to low concentrations	High	High	CO_2 plus byproducts	High power requirements, oxidants may be toxic. Potential for toxic breakdown products to be formed.	No--Not demonstrated for large-scale application. Further analysis is required regarding the potential formation of general oxidation products prior to application in large drinking water systems. The process may be feasible for smaller capacity systems, particularly where VOC concentrations are relatively high and a nonpotable water use is specified.

Source: City of Scottsdale, Operable Unit Feasibility Study for Remediation of Groundwater in the Southern Scottsdale Area. Prepared by Malcolm Pirnie. April 1988.

Chapter 3 of the Scottsdale OU of Ground Water Treatment Remedial Technologies for Indian Bend Wash, prepared in September 1987, provides more detail on the screening process.

EVALUATION OF ALTERNATIVES

GROUND WATER ALTERNATIVES

P.0 No-Action Alternative

The no action alternative would allow contaminated ground water to spread over a widening area and, in light of the proposed increased usage of ground water in the area, cause adverse environmental and health consequences.

Pumping of Ground Water

Each pumping alternative (P.1 through P.4) is potentially feasible and satisfies the objectives of CERCLA and SARA by reducing the amount of contamination in the Middle and Lower Alluvium Units. They also satisfy the objectives of the OUFS in stopping contaminant migration and supplying a source of water for the City of Scottsdale.

TREATMENT ALTERNATIVES

Both air stripping and activated carbon adsorption achieve the desired goal of reducing volume and toxicity of the ground water sufficiently to meet the applicable and appropriate requirements and will likely exceed these requirements. Table VI-3 presents the treatment goals and water quality design criteria. Treatment of contaminated ground water, either by air stripping or the use of granular activated carbon, has been shown to be very effective, with removals of organics often exceeding 99.9 percent. These processes are relatively predictable, and they have been used successfully at a number of CERCLA sites.

The air stripping and adsorption facilities will require operator attention for periodic monitoring, maintenance inspections, and water sampling. With industrial grade components and regular preventive maintenance, process integrity should be 25 years or more. If periodic cleaning of the packing and internals due to scaling becomes necessary, provisions for adding antiscalant will be made during the preliminary and final design phases.

Neither of the treatment alternatives will require unusual construction materials or practices. It is estimated that either facility could be designed and constructed in 18 to 24 months.

The City of Scottsdale has requested that vapor phase GAC adsorption be included to remove VOCs from the packed column emissions.

VOCs other than TCE, chloroform, PCE, 1,1-DCE, and 1,1,1-TCA have been detected in some monitoring wells. The most prevalent of these other VOCs are toluene and methylene chloride. Given the design criteria developed for treatment of the most commonly detected VOCs at IBW, toluene would be effectively removed by either air stripping or GAC adsorption. Methylene chloride would be removed by air stripping at 95 percent efficiency.

Since the treated water will be for municipal use rather than reinjection, both air stripping and carbon adsorption were evaluated based on the criteria of treating the water to meet ARARs. The alternatives were considered further for treatment below the ARAR levels.

Table VI-3
WATER QUALITY DESIGN CRITERIA
FOR EVALUATION OF TREATMENT TECHNOLOGIES

Treatment to Meet ARARs:

		Average Water Quality		"Worst Case" Water Quality	
	Treatment Goal (µg/l)	Influent (µg/l)	Percent Removal	Influent (µg/l)	Percent Removal
Chloroform	0.5	10	95.00	50	99.00
1,1-dichloroethylene (DCE)	7	5	--	20	65.00
Tetrachloroethylene (PCE)	0.67	20	96.65	100	99.33
1,1,1-trichloroethane (TCA)	200	ND	--	10	--
Trichloroethylene (TCE)	5	300	98.33	1,500	99.67

Treatment to Exceed ARARs:

		Average Water Quality		"Worst Case" Water Quality	
	Treatment Goal (µg/l)	Influent (µg/l)	Percent Removal	Influent (µg/l)	Percent Removal
Chloroform	0.5	10	95.00	50	99.00
1,1-dichloroethylene (DCE)	3.5	5	30.00	20	82.50
Tetrachloroethylene (PCE)	0.5	20	97.50	100	99.50
1,1,1-trichloroethane (TCA)	100	ND	--	10	--
Trichloroethylene (TCE)	3	300	99.00	1,500	99.80

Note: ND denotes nondetectable.

VII. SELECTED REMEDY

DESCRIPTION

Presently, the preferred alternatives for the Scottsdale Ground Water Operable Unit are:

Containment Alternative--Ground water will be extracted from the Middle and Lower Alluvium Units by pumping City of Scottsdale Wells No. 31, 71, 72, and 75 at a minimum of 75 percent of their historical capacities (P.2). This alternative is chosen because it utilizes existing wells and appears to be the most effective for reducing the amount of TCE during the first years of operation (See Table VI-1). Once the system is operating and the effectiveness of removing VOCs from the Middle and Lower Alluvium Units can be further evaluated, additional pumping of these wells (up to 100 percent of their original capacities) and the use of additional extraction wells will be considered. The pumped water will be sent to the City of Scottsdale water system for potable use after contaminant levels are reduced to meet primary drinking water standards.

Treatment Alternative-Air Stripping with Air Emission Controls--The extracted ground water will be sent through a collection system to a centralized treatment facility. Air stripping will be used since all of the contaminant levels can be lowered to meet drinking water standards at a lower cost than by using granular activated carbon. Specifically, packed column aeration will be used in which the water passes over the packing material by gravity. Air is forced upwards through the column to provide a counter-current flow. The VOCs are transferred from the water to the air and exhausted at the top of the columns. Vapor phase GAC adsorption will be used to remove VOCs from the air waste stream from the treatment plant.

End Use--To completely satisfy the objectives of the Operable Unit, the end use will be distribution to the City of Scottsdale water system. Any recharge project proposed by the City of Scottsdale will be evaluated for any adverse impact on the Operable Unit.

After 50 years of operation, the chosen alternative is estimated to remove between 79 and 85 percent of the present mass of TCE in the Lower and Middle Alluvium Units. This remedy will provide potable water to the city while utilizing existing facilities, improve the regional aquifer's suitability for potable use by removing contaminants, and protect public health and the environment by protecting unaffected wells from VOCs. It also fulfills the statutory preference for permanent solutions at Superfund sites.

Present worth cost estimates for the pumping and air stripping treatment alternative are presented in Table VII-1. Costs include piping and treatment equipment, maintenance, regeneration of vapor phase GAC, and engineering and design. The estimates are based on a system capacity equal to the historic pumping capacities of Wells 31, 71, 72, and 75 (8,400 gpm) and the treatment goals in Table VII-2. If the MCLs for the VOCs or other constituents such as heavy metals are changed, the remedy will be reevaluated to determine if a design modification is necessary. Cost estimates were initially developed for two alternatives within the air stripping alternative. One considered stainless steel columns with circular cross sections, and the other considered concrete columns with rectangular cross sections. The estimates presented in Table VII-1 are based on the concrete columns, which is the preferred design.

STATUTORY DETERMINATIONS

CERCLA, and its reauthorization, SARA, requires that permanent reductions of contaminants through treatment be preferred over containment alternatives. It also requires that Applicable or Relevant and Appropriate Requirements (ARARs) be used to determine the treatment levels. By achieving these requirements, the selected remedy for the Scottsdale Ground Water Operable Unit reduces the present and future risks associated with use of the ground water in the Scottsdale area. By reducing the contaminant levels and restricting their mobility, this remedy protects both human health and environmental quality.

Table VII-2 shows the ARARs identified for the ground water and the proposed treatment goals. Contaminant levels found in the IBW wells are greater than the Safe Drinking Water Act maximum contaminant levels and the Arizona Department of Health Services action levels.

Table VII-1
PRELIMINARY COST ESTIMATES--PRESENT WORTH ANALYSIS
PACKED COLUMN AERATION WITH VAPOR-PHASE GAC AND
PUMPING OF EXISTING WELLS

Total Capital Cost	$4,008,000
Annual Operating Cost	520,000
Present Worth of Operating Costs at 10 percent	4,720,000
Total Present Worth at 10 percent	8,728,000

Notes: System capacity = 8,400 gpm.
Present worth factor is based on an annual interest rate and 25 years of operation.

The selected remedy satisfies the requirements for treatment and risk reduction, and does so economically. Initial analysis of the pumping regimen indicates the volume of contaminated ground water and mass of VOCs will be reduced.

Of the proven technologies, air stripping proved to be the most economical treatment method available, both for capital and operating costs. It will also reduce residual wastes to a minimum.

Distribution of the treated water to the City of Scottsdale water system is the only end use that will satisfy the objective of providing a potable water source to the City. The selected remedy satisfies the requirement of reducing the mobility, toxicity, and volume of contaminated water. It does so by using treatment technology to the maximum extent practicable and does so in a cost-effective manner.

Table VII-2
STATE AND FEDERAL
APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS[a]
AND OTHER CRITERIA
(concentrations in ppb)

Compound	SDWA MCL	SDWA MCLG	ADHS Action Level	Treatment Goal
Trichloroethene	5	0	5	5
1,1,1-Trichloroethane	200	200	200	200
1,1-Dichloroethene	7	7	7	7
Perchloroethene			1	0.67
Chloroform[b]			3	0.5

[a]Clean Water Act requirements will be determined during NPDES review.

[b]Source is not a byproduct of municipal water supply chlorination.

Notes: ADHS--Arizona Department of Health Services
AWQC--Ambient Water Quality Criteria
MCL---Maximum Contaminant Level
MCLG--Maximum Contaminant Level Goal
SDWA--Safe Drinking Water Act

Sources: U.S. EPA 1986. Public Health Assessment Manual
ADHS 1987. S. Eberhart

VIII. REFERENCES

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Doull, J., C. D. Klaassen, and M. D. Amdur. 1980. Toxicology. MacMillan.

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U.S EPA. 1986. Superfund Public Health Evaluation Manual. Washington, D.C.: Office of Emergency and Remedial Response, Office of Solid Waste and Emergency Response.

U.S. EPA. 1985. Chemical, Physical, and Biological Properties of Compounds Present at Hazardous Waste Sites. Final Report. Washington, D.C.: Office of Waste Programs, Enforcement, Office of Solid Waste and Emergency Response.

RDD/R48/012

Appendix A
INDEX OF ADMINISTRATIVE RECORD

Appendix A
INDEX OF ADMINISTRATIVE RECORD

March 1984 Ecology and Environment, Inc.	Review of Chemical Characterization of Soil from the Chemical and Electronic Shop Disposal Line Break at Motorola. Motorola, Inc. Government Electronics Group. March 27, 1984. Reviews report of leak in Motorola wastewater effluent line by Dr. Wallace Fuller (Motorola consultant).
June 1984 Ecology and Environment, Inc.	Final Work Plan RI/FS Indian Bend Wash Site. Phoenix, Arizona. June 1984. Describes the activities to be carried out and the methodology for the Remedial Investigation and Feasibility Study of the Indian Bend Wash area.
July 1984 Ecology and Environment, Inc.	Sample Documentation Report Indian Bend Wash. Remedial Investigation. Scottsdale, Arizona. July 2, 1984. Discusses the well sampling effort performed during the weeks of October 29 and November 3, 1984, throughout the IBW study area.
September 1984 Ecology and Environment, Inc.	Final Community Relations Plan. Indian Bend Wash. Phoenix, Arizona. September 1984. Prepared as part of Phase I of the RI/FS to provide a means of gathering background, site history, and a discussion of the concerns of interested parties.
November 1984 Ecology and Environment, Inc.	Quality Assurance Project Plan. Indian Bend Wash and Phoenix-Litchfield Airport Area Sites. November 1984.

November 1984 (continued)	Describes procedures for ensuring quality control and reliability of sampling procedures, field measurements, equipment maintenance, analytical procedures, data management, and document control.
February 1985 Errol L. Montgomery and Associates, Inc.	<u>Phase II Results of Motorola Inc. Hydrogeologic Investigations On-site Monitor Wells.</u> Motorola Inc. Government Electronics group. Scottsdale Plant, Maricopa County, Arizona. February 22, 1985. This report provides results of hydrogeologic investigations conducted at the Motorola Inc. Scottsdale plant.
November 1985 Errol L. Montgomery and Associates, Inc.	<u>Phase I Off-site Results of Motorola Inc. Hydrogeologic Investigations Phase I Off-site Monitor Wells</u>. Motorola Inc. Government Electronics Group. Scottsdale plant. Maricopa County, Arizona. November 21, 1985. This report provides results of Phase I hydrogeologic investigations conducted in the Indian Bend Wash Area.
March 1986 The Mark Group	<u>Hydrogeology Report (Former) Beckman Instruments, Inc. Site</u>. Scottsdale, Arizona. March 21, 1986. Provides results of soil and soil gas sampling and analysis, monitor well construction and sampling, theoretical analysis of trichloroethene transport, and interpretation of both onsite and offsite data at the former Beckman site.

May 1986 Ecology and Environment, Inc.	<u>Draft Phase I Task Report. Indian Bend Wash. Remedial Investigation</u>. Scottsdale, Arizona. May 19, 1986. Defines the ground water flow patterns in the study area, determines the vertical and lateral extent of ground water contamination, estimates the volume of ground water impacted, determines potential sources of contamination, and obtains data for use in the Feasibility Study.
December 1986 U.S. EPA	<u>Interim Guidance on Superfund Selection of Remedy.</u> December 24, 1986. Provides new guidance on the selection of remedial actions in the absence of a new edition of the NCP. Incorporates Superfund Amendments and Reauthorization Act of 1986 (SARA).
July 1987 U.S. EPA	<u>Interim Guidelines on Compliance with Applicable or Relevant and Appropriate Requirements</u>. July 9, 1987. Provides new guidance on selection of ARARs and MCLs as cleanup standards for Superfund sites. Incorporates SARA.
August 1987 Black and Veatch	<u>Soil Sampling Plan. Indian Bend Wash, RI/FS</u>. August 10, 1987. Describes the objectives of the investigation of the vadose zone at Indian Bend Wash.
September 1987 CH2M HILL	<u>Evaluation of Groundwater Treatment Remedial Alternatives. Indian Bend Wash.</u> September 9, 1987.

		Describes and evaluates groundwater treatment technologies and provides order-of-magnitude costs for those discussed.
October 1987	CH2M HILL	Evaluation of Potential Water Use Alternatives. Indian Bend Wash. Remedial Investigation. October 16, 1987. Presents an evaluation of potential water user alternatives near the IBW site if ground water is extracted and treated.
November 1987	Errol L. Montgomery and Associates, Inc.	Results of 10-Day Middle Alluvium Unit Aquifer Test February-March 1987. Motorola Inc., Government Electronics Group. Scottsdale, Arizona. November 20, 1987. This report gives the results of a 10-day aquifer test at pumped Well (A-1-4) 1abb1 [SRP 23.6E, 6N] in the Indian Bend Wash area.
December 1987	CH2M HILL	Groundwater Field Sampling Plan Phase II/Stage 2 Remedial Investigation. Indian Bend Wash Site. Scottsdale, Arizona. December 1987. This scope of work discusses the installation and testing of six new monitoring wells at Indian Bend Wash site.
February 1988	CH2M HILL	Technical Memorandum Soil Gas Results. Indian Bend Wash RI/FS. Scottsdale, Arizona. February 5, 1988. Discusses soil gas sampling and mobile analysis conducted at the IBW Superfund site during February 1987, June 1987, and December 1987.

April 1988	City of Scottsdale, Arizona	<u>Public Comment Operable Unit Feasibility Study for Remediation of Groundwater in the Southern Scottsdale Area</u>. Malcolm Pirnie. April 1988. Discusses, screens, and evaluates remedial actions for providing an expedited cleanup of the Scottsdale Operable Unit.

RDD/R32/016

Appendix B
RESPONSE SUMMARY

OPERABLE UNIT FEASIBILITY STUDY (OUFS) FOR REMEDIATION OF GROUNDWATER IN THE SOUTHERN SCOTTSDALE AREA

OVERVIEW

During the public comment period for the April 1988 OUFS (Draft for Public Comment) from April 19 through May 18, 1988, EPA received comments on the recommended partial remedy for ground water at the Indian Bend Wash (IBW) area. Comments were received from State regulatory agencies and from businesses presently or previously located in the IBW area. EPA also received comments from the general public at its Public Meeting held May 5, 1988, at Scottsdale City Hall.

Most of the comments received were of a technical nature. Substantial technical comments are responded to herein. None of the comments raised issues that would affect EPA's selection of a partial remedy or require reissuance of a revised OUFS. Therefore, the April 1988 Public Comment OUFS, along with clarification provided by this Response Summary, shall constitute the Final OUFS for this project.

SUMMARY OF PUBLIC COMMENTS AND AGENCY RESPONSES

GENERAL COMMENTS

From Arizona Department of Water Resources;
Arizona Department of Environmental Quality

1. Concerns were expressed regarding the level of detail in discussions of ground water pumping alternatives, new water quality data obtained for Scottsdale Well No. 76, and the limitations of analysis results obtained from the two-dimensional ground water model utilized.

RESPONSE: The purpose of the two-dimensional model is to evaluate the feasibility of various pumping regimens to achieve the remedial action objectives for ground water stated in the OUFS: (1) to protect unaffected wells from VOCs, and (2) to improve the regional aquifer's suitability for potable use. Although the two-dimensional model is more simplistic than a properly constructed and operated three-dimensional model, the two-dimensional model adequately considers the hydrogeologic conditions, and the projections are suitable to evaluate the feasibility of pumping to achieve the ground water remediation objectives of the OUFS. Additional detailed modeling may refine the understanding of the complex hydrogeologic system; however, a higher degree of detailed modeling is not required for the purposes of the OUFS. It should be noted that the Operable Unit remedy is designed to be a partial remedy, and additional modeling and consideration of other potentially feasible pumping alternatives will be considered in the overall FS for the IBW area. Acquisition of new water quality data and further work with ADWR's three-dimensional model is encouraged, and new available data should be used, when appropriate, to propose modifications to the remedial action program to more effectively achieve the objectives of the remedy.

Results of computer modeling cannot be regarded as absolute and must be considered using professional discretion. For practical purposes, Scottsdale Well No. 76 was simulated as an extraction well in two pumping regimens and is located on the 5 μg/l TCE contour for initial modeling conditions. The model results predict that Well No. 76 could soon be affected with low concentrations of VOCs; and this has been verified by recent sampling, after which the well was removed from potable service. The model results do not indicate that there will be no further migration of the zone of contamination. The results do suggest that under the pumping regimens used for modeling operations, migration should not be substantial and the areal extent of affected ground water should be reduced. Pumping regimens used for modeling operations were based on the assumption that pumping patterns in the model area would remain unchanged. Attempting to predict future pumping patterns throughout the model area based on historic pumping data is at best an approximation, but a necessary one for this modeling application. In no way do the model's limitations indicate that the proposed partial remedy may not achieve the remedial action objectives stated in the OUFS.

SPECIFIC QUESTIONS AND COMMENTS

From EPA Region IX, Quality Assurance Management Section

1. The OUFS report mentions sampling programs and water quality in the Background and Site History Section, but the actual quality of the data is not mentioned. The author should discuss whether the quality of the data was determined, and whether the data quality was considered in developing potential remedial actions at the IBW site.

RESPONSE: The presentations of water quality data in the OUFS are brief summaries of extensive available data from monitor wells and affected City wells. These data were summarized in order to provide a manageable database from which to estimate potential water quality from extraction wells for use in treatment analyses. All monitor well sampling and analyses were performed in accordance with EPA Contract Laboratory Program (CLP) procedures for Quality Assurance/ Quality Control. QA/QC results were accounted for during compilation of the water quality data summaries in the OUFS and were a major factor in limiting the list of VOCs of concern to five compounds. In addition, potential impacts on the treatment alternatives by two other compounds (toluene and methylene chloride) are evaluated in Section 5 of the OUFS because, although very limited in occurrence, some of the analyses that indicated detectable results of these compounds in monitor wells appeared to pass QA/QC criteria. As stated on page 1-6, paragraph 2 of the OUFS, more extensive presentations of water quality data can be found in the Remedial Investigation and related reports, although the cited references should be 1, 3, 4, 5, and 6, not 4 through 8 as shown.

From Beckman Instruments, Inc.

1. The OUFS should include additional consideration of whether the proposed remedy is consistent with the current state of knowledge of the Upper Alluvium Unit and any ultimate remedial program for the unit. The Upper Alluvium Unit in the southerly portions of the North IBW site contains significant quantities of water and VOCs, and we believe the distribution of chemicals of concern in the unit should be considered and discussed further in the OUFS.

RESPONSE: The current understanding of the hydrogeology of the Upper Alluvium Unit is summarized in Section 1 of the OUFS, and more detailed discussions are available in the Remedial Investigation and other related reports included in the administrative record. Potential impacts of Upper Alluvium Unit ground water on the remedial action alternatives are examined thoroughly in Sections 4 and 5 of the OUFS, and will also be considered during final design of the partial remedy. The proposed partial remedy of pumping contaminated wells and subsequent treatment for potable use will not be inconsistent with the final remedy for the IBW site, and the current migration of VOCs from the Upper to the Middle and Lower Alluvium Units through short-circuiting in wells and low-rate percolation will continue whether or not the proposed remedy is implemented. As stated in the OUFS, sealing of well casings in the Upper Alluvium Unit would not eliminate the downward migration of VOCs, and is not necessary because the proposed partial remedy will accommodate impacts from Upper Alluvium Unit contamination and provide for some level of cleanup for Upper Alluvium Unit water. The OUFS is not intended to provide a final remedy for the entire IBW site. EPA will address the Upper Alluvium Unit further in the overall Feasibility Study.

2. Why was the 1×10^{-6} level used in establishing several "Other Criteria" and "Treatment Goals to Meet ARARs" rather than a 1×10^{-5} or 1×10^{-4} level? Why were the "Treatment Goals to Exceed ARARs" for some chemicals fixed at one-half the MCLs rather than at other levels closer to the MCLs?

RESPONSE: ARARs and Other Criteria were established for the OUFS in accordance with "EPA Interim Guidance on Compliance With Other Applicable or Relevant and Appropriate Requirements" (52 FR 32496 et seq) and in conference between the City of Scottsdale and EPA Region IX Toxics and Waste Management Division Officials. For chemicals that have not been assigned Safe Drinking Water Act Maximum Contaminant Levels MCLs), it is EPA's policy to set cleanup levels (for potable end use) such that the total additive excess lifetime cancer risk of all chemicals present in the treated water fall within the range of 10^{-4} to 10^{-7}. As a general matter, EPA recommends consideration of a risk level of 10^{-6}, since this level is effective in protecting human health and the environment and can be reasonably implemented.

The National Contingency Plan (NCP) requires the evaluation of alternative remedial actions that will achieve and exceed ARARs. EPA has not established guidelines for quantitatively determining cleanup levels that "exceed ARARs." However, the identified "Other Criteria" were chosen for carcinogens, and one-half of the MCLs were chosen for non-carcinogens as treated water levels which would illustrate the differences in cost-effectiveness for the treatment alternatives based on achieving a significantly higher public health risk reduction than would be achieved when "meeting ARARs." This is the intent of the dual-analyses provision of the NCP. It should be noted that analyses in Section 5 of the OUFS indicated that no practical differences in the design criteria, capital costs, and operating and maintenance costs occur between the two sets of treatment goals due to the nature of the treatment processes evaluated. Also, neither of the VOCs that had treatment goals set at one-half of the MCL were determined to be controlling constituents in the treatment analyses.

From Arizona Department of Environmental Quality

1. The 5 µg/l TCE contour surrounding the zone of ground water contamination is identified on Figure 6, Appendix A. Data defining the occurrence and concentrations of contaminants in some of the study area are incomplete

or lacking. What specific data in these areas were used to establish the 5 μg/l boundaries?

RESPONSE: All available ground water chemistry data were used to construct water quality data matrices, and the concentrations of TCE were contoured as accurately as possible using these data. The zone of contamination was defined and the model was constructed using the best available data. Although the extent of contamination is not, and may never be, precisely defined, the effectiveness of pumping and treatment of contaminated ground water can be evaluated using available data. Future work may provide data that would more accurately delineate the zone of contamination; however, those data are not available at this time. It is premature to draw a final conclusion regarding the extent of contamination, but it is not premature to make qualitative conclusions about the effectiveness of pumping as a ground water control for the OUFS.

2. Ground water inflow via leakage from the Upper Alluvium Unit was not included in the model recharge because it is not believed to be substantial relative to other recharge sources. It should be noted that contaminant movement from the Upper to the Middle and Lower Alluvium Units is believed to be the primary mechanism for the occurrence of deeper contamination. What data, calculations, and assumptions were used to determine the recharge volume of the Upper Alluvium Unit? How do these calculated volumes specifically compare to the other recharge sources?

RESPONSE: Results of recently completed fluid-movement investigations in the Indian Bend Wash area production water wells indicate that water from the Upper Alluvium Unit migrates to the Middle Alluvium Unit and Lower Alluvium Unit via existing wells which serve as conduits for ground water transport. Water from the Upper Alluvium Unit moves down the well casing to the underlying aquifer units where water moves into the lower part of the Middle Alluvium Unit and into the Lower Alluvium Unit through perforations at that level. Ground water is also believed to migrate from the Upper Alluvium Unit to the underlying units via movement in the annular space between the casing and the borehole wall. Leakage from the Upper Alluvium Unit is believed to be substantially less than migration via these methods. The volume of water contributed to the Middle Alluvium Unit via leakage from the Upper Alluvium Unit is believed to be small relative to underflow, and leakage was not considered for this modeling investigation. ADWR has conducted a detailed study of the water budget for the IBW area and has calculated recharge to the Middle Alluvium Unit via leakage. Because ADWR leakage values were based on an unreliable flow net analysis, a low level of confidence was assigned to the

ADWR values for leakage, and leakage was not used for the model. (See response to ADWR Comment No. 20.)

3. The TCE is assumed to be in a dissolved phase and was modeled as a nonreactive tracer. Should TCE more accurately be modeled as a nonreactive tracer with the appropriate retardation coefficient?

RESPONSE: TCE tends to adsorb onto organic carbon, and the migration of TCE in contaminated water is thereby retarded. A retardation coefficient could be used in the solute transport model to simulate this adsorption. The results would indicate zones of contamination of smaller areal extent than results obtained by assuming no retardation. VOC-affected ground water migrates fastest in the coarse gravel zones in which there is less organic carbon and retardation would not be expected to be substantial.

From Arizona Department of Water Resources

1. Paragraph 4 on page ES-5 seems unclear. Are P.2, P.3, and P.4 no more effective than P.0, or P.1?

RESPONSE: There is an error in this paragraph. Page ES-5, paragraph 4, sentence 2 should read: "Modeling results indicated that all of these other alternatives were significantly more effective in managing the affected ground water zone than pumping Alternative P.0 (no-action)."

2. On Table 3-1, injection should be addressed because it appears to be a viable ground water control for this area.

RESPONSE: Injection is not addressed because it is not compatible with the fundamental remedial action objective of potable end use for the City of Scottsdale.

3. The effects of Upper Alluvium Unit contamination and its impacts on this OUFS should be more fully addressed.

RESPONSE: Based on the best available data, the potential impacts of the Upper Alluvium Unit on the remedial action alternatives are thoroughly discussed and evaluated in Sections 4 and 5 of the OUFS. As additional data become available, they will be examined with respect to potential impacts on the selected partial remedy during final design and will be addressed in the overall FS for the IBW site.

4. Do the proposed pumping alternatives exclude the Upper Alluvium Unit?

RESPONSE: None of the extraction wells for VOC-affected ground water in Pumping Regimens P.1 through P.4 will pump primarily Upper Alluvium Unit water. However, short-circuiting is occurring in some of the wells, and Upper Alluvium Unit water which migrates down the well, whether inside or outside of the casing, will be pumped. As stated in Sections 4 and 5 of the OUFS report, the potential impacts of this water have been accommodated in treatment facility analyses. The Upper Alluvium Unit will be addressed further in the overall FS for the IBW site.

5. Was the City of Scottsdale's CAP allotment and conservation measures called for in the Second Management Plan taken into account in the modeling of the various pumping regimens?

RESPONSE: Pumping regimen analyses are compatible with the demand projections of the City of Scottsdale's Water Resources Management Plan, June 1987. As stated in the Institutional Analysis portion of Section 5, Scottsdale has service area rights to pump the ground water within the limitations of its Active Management Area targeted per capita usage goals for the entire service area.

6. Regarding the Ground Water Management Act of 1980, the applicability of the Act is that it requires remedial actions to be consistent with the Act and are subject to management goals established by the AMA in which remedial actions are located. All of the alternatives of the remedial action are affected as they are under the jurisdiction of and require the approval of the Department of Water Resources.

RESPONSE: The Arizona Department of Water Resources, as well as Environment Quality, will be asked to concur with EPA's Record of Decision.

7. DWR is concerned with the justification and effect of constant head cells at most of the ground water model's boundaries, the effect of not inputting recharge into the model, the effect of not utilizing the Upper Alluvium Unit as a source of contaminants, and the effect of not knowing the western edge of the zones of contamination in the Middle and Lower Alluvium Units.

RESPONSE: No-flow cells are used to represent Camelback Mountain and Mummy Mountain, where the geologic formations are believed to have very low permeability. The remaining boundary cells are designated as constant head cells to simulate ground water underflow into the model area. The effect of constant head boundary cells is that drawdown will not occur within these cells. Because these boundaries are substantial distances from pumping centers used in the modeling operations, this approximation does not have a substantial effect on migration of the zone of contamination.

Recharge into the combined Middle and Lower Alluvium Units aquifer in the model area is believed to be small in relation to underflow into the model area. Analysis of water level hydrographs for the Upper, Middle, and Lower Alluvium Units indicates that recharge into the Upper Alluvium Unit has little effect on the pattern of ground water flow in the lower units, and recharge was not considered in the two-dimensional model.

The effect of not considering the Upper Alluvium Unit as a source of contamination in the model is that the contamination problem could continue for a longer period of time than if it were considered. To disregard the Upper Alluvium Unit as a source of contamination does not affect the areal extent of contamination in the combined Middle and Lower Alluvium Unit, but it may result in an underestimation of the length of time that contaminated ground water will occur in the aquifer system.

The zone of contamination was estimated for the model using the best available data. The feasibility of pumping and treatment of ground water was evaluated based on available data. If additional water quality data become available for the western part of the study area, the zone of contamination could be delineated more precisely, and pumping regimens might be refined to more effectively remove contamination. At this time there are no monitor wells or production water wells in the western part of the study area; therefore, precise definition of the western boundary of the zone of contamination is problematic. However, available data are adequate to conclude that pumping and treatment is a viable remedial action, and the requirements for the OUFS are met.

8. The number and complexities of the proposed remedial actions are limited and should be expanded to explore ways of minimizing cleanup time and enhancing containment.

<u>RESPONSE:</u> There are a number of potential scenarios for remedial action. The alternatives in the OUFS covered a broad spectrum while trying to identify reasonable actions that could be easily implemented.

The following comments were directed to specific sections of Appendix A--Ground Water Modeling:

9. Page 3, paragraph 2: The saturated thickness of the Upper Alluvium Unit reaches a maximum of 60 feet or more in the southern part of the model area.

<u>RESPONSE:</u> Comment noted.

10. Page 4, paragraph 1: Ground water flow directions are quite different than north and northwest in the central and north parts of the model area, where localized cones of depression exert influence.

RESPONSE: Ground water flow directions discussed in Appendix A are general flow directions for ground water in the alluvium units. This particular paragraph indicated the direction of ground water movement in the Middle Alluvium Unit in areas where water level measurements in monitor wells have been made.

11. Page 4, paragraph 2: The thickness of the Lower Alluvium Unit in the IBW area is probably greater than "200 to 600 feet." According to Oppenheimer and Summer (1980), total thickness of sediments below the Middle Alluvium Unit is on the order of 4,000 feet in the northeast part of the model area. Much of this thickness is composed of the Red Unit, but the thickness of the Lower Unit is really unknown in most of the study area.

RESPONSE: Thickness for the Lower Alluvium Unit given in the report was derived from analysis of drillers logs on file with ADWR.

12. Page 5, paragraph 2: It should be stated that the Lower Alluvium Unit is probably a much more important aquifer than the Red Unit in the south part of the Paradise Valley basin.

RESPONSE: Comment noted.

13. Page 7, paragraph 2: Under "model input," more data are needed to adequately evaluate the model. Can you please provide ADWR with the data matrices input into the model? Also, we would like copies of MODFLOW and MOC model runs in order to review the models' assumptions and limitations in an effective manner. Additionally, the uncertainty associated with most assumptions should be stated, and a range of possible values discussed.

RESPONSE: Errol L. Montgomery & Associates, the developer of the model and author of Appendix A to the OUFS, will continue to be available to discuss the ground water model in detail with representatives from ADWR.

14. Page 8, paragraph 1: Along the north, south, and east boundaries, constant head nodes are employed. Comparison of 1982 with 1988 water level measurements from wells located within one-half mile of those boundaries shows that, in the last 6 years, water levels have risen from 23 to 161 feet in the north, and have dropped 49 feet in the east. This suggests that the north and

east boundaries are not actually constant head areas, as the model assumes. Input of variable head boundaries would greatly affect the model's results, and the effect of such variation in heads should be explored during the sensitivity analysis process to see if the proposed remedial actions are affected.

RESPONSE: If sufficient data were available to accurately calculate flux along the boundary, then a head dependent prescribed flux boundary condition would be more accurate than a constant head boundary condition. However, data are limited and an algorithm for head dependent flux would be very approximate. The model boundaries are located at substantial distances from the zone of contamination (the area of concern for the modeling investigation) and do not substantially affect water levels in that area. Because of the location of the area of concern and the limited data available, the constant head boundary cells are believed to adequately approximate the hydrologic conditions and are suitable to evaluate the proposed partial remedy.

15. Page 8, paragraph 1: The use of constant head nodes at the western model boundary appears to be unjustified, unless transmissivity values are so low as to effectively simulate no-flow cells. Constant head cells may provide considerable underflow into the model area, and this underflow may not be actually occurring between Papago Buttes and Camelback Mountain, where depth to bedrock is probably less than 100 feet, and on the east side of the Papago Buttes. How much inflow is simulated along the western boundary? The effect of inappropriately large inflow values from the west (and north) may be to disallow contaminant transport to the west (and north). Migration of the contaminant zone along its western and northern margin in all pumping scenarios is minimal, even in contaminated areas inside or adjacent to cones of depression of extraction wells. Historically the zone of contamination has most likely migrated a considerable distance to the west and north, a situation not simulated by model results. The lack of contaminant migration along the western margin of the zone of contamination may be an effect of assuming unrealistically high ground water inflow values from the western boundary.

RESPONSE: The hydraulic head west of Papago Buttes, Camelback, and Mummy Mountains is substantially higher than the hydraulic head in the Paradise Valley basin. The steep hydraulic gradient and the coarse-grained lithology of the sediments allow large amounts of ground water to enter the Paradise Valley basin as underflow, even though saturated thickness between Papago Buttes and Camelback Mountain and between Camelback Mountain and Mummy Mountain may be relatively small.

16. Page 8, paragraph 2: Uncertainties of the flow net analysis should be stated (for example, the lack of detailed water levels and gradients, unknown leakage from the Upper Alluvium Unit, and unknown recharge from land surface to the Middle Alluvium Unit where the Upper unit is not saturated).

RESPONSE: Comment noted.

17. Page 8, paragraph 3: Could you provide a reference for the reported values of storage coefficient?

RESPONSE: Several references are given at the end of Appendix A. In addition to references cited in the report, studies by the U.S. Geological Survey and Arizona Department of Water Resources, which include data for the Indian Bend Wash area, were used to provide estimates for storage coefficient.

18. Page 9, paragraph 9: How sensitive is the model to the assumption that the Lower Alluvium Unit maintains a constant thickness?

RESPONSE: Pumping is the most sensitive stress on the ground water system. In the Lower Alluvium Unit, the altitude of the bottom of the perforations is substantially higher than the base of the Lower Alluvium Unit. Therefore, the sensitivity of the model to the thickness of the Lower Alluvium Unit is small. In effect, to estimate the thickness of th Lower Alluvium Unit is to estimate the transmissivity, so the sensitivity of the thickness of the Lower Alluvium Unit is less than the sensitivity of transmissivity.

19. Page 9, paragraph 1: Ground water recharge is usually considered to be a separate component from ground water underflow. Ground water recharge is here defined as deep percolation from the land surface to the aquifer, which is a different form of inflow than ground water underflow. A separate section on ground water recharge (as here defined) should be included in the report for completeness.

RESPONSE: For purposes of the modeling investigation, which deals only with the Middle and Lower Alluvium Units, ground water recharge is considered to be negligible.

20. Page 10, paragraph 1: In the ADWR IBW water budget memo dated 9/9/87, ground water recharge via leakage from the Upper Alluvium Unit and via direct recharge into the Middle Alluvium Unit was estimated to be equal to about 150 percent of total pumpage and about 200 percent of ground water underflow. Not taking recharge into the Middle Alluvium Unit into account is a limiting assumption of the model and should be discussed more fully.

RESPONSE: Additional evaluation of the estimates of underflow and recharge in the ADWR water budget is required. The ADWR flownet shows converging streamlines which imply infinite transmissivity. The Operable Unit model assumes that recharge is small relative to underflow, and therefore, recharge is disregarded in the two-dimensional model, although additional discussions with ADWR concerning this analysis are warranted.

21. Page 11, paragraph 2: Better water level data now available indicate head differences between composite wells and Middle Alluvium Unit-only or Lower Alluvium Unit-only wells range from as low as 10 feet where little pumping occurs to as much as 70 feet in areas where heavy pumping occurs.

RESPONSE: Comment noted.

22. Page 12, paragraph 1: Effective porosity is reported to be 25 percent, but on page 8 the specific yield is reported to be 10 percent. Which value was used in the model? This is particularly important because the model is reported to be sensitive to variations in effective porosity (page 13).

RESPONSE: Effective porosity was used for MOC, and specific yield was used for MODFLOW.

23. Page 12, paragraph 2: Can you please provide a reference for the reported values of dispersivity?

RESPONSE: Appropriate references can be found in: Hargis & Montgomery, 1982. Digital Simulation of Contaminant Transport in the Regional Aquifer System, U.S. Air Force Plant No. 44, Tucson, Arizona; Interim Report, October 11, 1982.

24. Page 12, paragraph 3: How sensitive is the model to variations in initial TCE concentration, particularly along the western margin of the zone of contamination which is basically undefined? Given the lack of TCE data in the west, what would be the effect of a "worst-case" scenario of contaminated ground water extending to the western boundary?

RESPONSE: If contaminated ground water extended to the western boundary of the model area, projections for the areal extent of contamination for the different pumping regimens would be larger. If water quality data become available to document this hypothetical zone of contamination, a new pumping regimen could be investigated to more effectively remove the contaminated ground water from the west.

25. Page 12, paragraph 3: The MOC model does not allow for introduction of additional contaminants into the system. Vadose zones in the Middle Alluvium Unit may contain sufficient TCE to provide a new source area not taken into account by the model. Additional sources not taken into account by the model include leakage-contaminated water from the Upper Alluvium Unit through cascading wells, as well as areawide vertical leakage from the Upper Unit. The effects of this model limitation are important and should be stated and discussed.

RESPONSE: Comment noted. The potential impacts of the Upper Alluvium Unit on the remedial action alternatives are thoroughly discussed and evaluated in Sections 4 and 5 of the OUFS.

26. Page 13, paragraph 3: The sensitivity analysis would be much more useful if provided in greater detail. Why were sensitivity runs for the flow model stopped after 5 years, but were run for 25 years for the transport model? What ranges of values were explored?

RESPONSE: The ground water flow system in the model approaches steady-state conditions after about 5 years after pumping starts. Therefore, the sensitivity analysis conducted on MODFLOW stopped after 5 years. The contamination distribution does not reach steady state, and 25 years was chosen as sufficient time for sensitivity analysis using MOC. Transmissivity, coefficient of storage, and hydraulic conductivity were varied by +20 percent. Effective porosity was varied by ±60 percent, and longitudinal dispersivity was varied by +400 percent.

27. The pumping values assigned to the different scenarios need justification by comparing them with future use projections for this area from the City of Scottsdale, the Phoenix Active Management Area, Paradise Valley Water Company, and/or Arcadia Water Company.

RESPONSE: For the purposes of the two-dimensional model, pumping patterns for wells other than the extraction wells for VOC-affected water were assumed to remain unchanged from 1986 pumping rates. As pumping in the future is documented, the model can be appropriately updated. (Also see response to ADWR Comment No. 5.)

SUMMARY OF PUBLIC COMMENTS AT
MAY 5, 1988 COMMUNITY MEETING
ON INDIAN BEND WASH SUPERFUND SITE

From Pamela Swift, Toxic Waste Investigative Group

1. EPA should study health impacts of past exposure to contaminated drinking water.

RESPONSE: It is the responsibility of the Agency for Toxic Substance and Disease Registry (ATSDR) to conduct a health assessment at each Superfund site.

2. EPA should put more effort into cost recovery.

RESPONSE: EPA will pursue cost recovery actions at Superfund sites in an appropriate manner.

3. DEQ should set up air toxics standards before the air stripper is built.

RESPONSE: No EPA comment.

4. City of Scottsdale should become more involved in this process--Mayor Drinkwater should hold a meeting with citizens.

RESPONSE: No EPA comment.

5. City of Scottsdale should consider impacts on EPA's projects when planning and zoning large projects that will need large amounts of water.

RESPONSE: No EPA comment.

From Carolina Butler, Scottsdale Resident

1. EPA should look at cancer rates among 40- to 50-year-old women who lived in the Indian Bend Wash area. Government should focus more on health problems.

RESPONSE: See No. 1 from above.